Journal of Network Computing and Applications (2021) 6: 31-35
Clausius Scientific Press, Canada
DOI: 10.23977/jnca.2021.060107
EISSN 2371-9214

Decision Model of Ordering and Transportation of Raw Materials Based on Big Data

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Keywords: TOPSIS entropy weight model, Multiobjective linear programming, SPSS

Abstract: This paper mainly studies the decision-making of enterprises for different suppliers and forwarders. Firstly, this paper preprocesses the given data and excludes the data with order quantity and supply quantity of 0. Then, in the quantitative analysis, the core indicators of decision-making are refined and summarized as: effective supply weeks, effective average supply quantity and effective residual. In quantitative analysis, the core indicators of decision-making are refined and summarized as: effective supply weeks, effective average supply quantity and effective residual. For these three core indicators, firstly, the effective residual is studied. In order to make vertical comparison between different suppliers, we first normalize their supply volume data before calculating the effective residual, so as to achieve the purpose of consistent comparison. Then, the square sum of the three indicators is normalized to make the three indicators consistent. Then the TOPSIS entropy weight model is called, and the corresponding ranking results are obtained through SPSS data analysis software and related formulas.

1. Introduction

It is one of the important strategic measures of the 14th five year plan and the long-term goal of 2035 to build a new development pattern with the domestic big cycle as the main body and the domestic and international double cycles promoting each other. The new development pattern emphasizes the need to adhere to expanding domestic demand as the basic point, strive to connect all links of production, distribution, circulation and consumption, and realize the effective connection between upstream and downstream and production and supply. The division of labor in China's manufacturing industry chain has gradually matured, from the rough processing of raw materials into semi-finished products, to the transportation and transportation of semi-finished products, and then to its fine processing into final industrial supplies, which has stabilized China's position as an "industrial power".

2. Multi attribute decision making model based on TOPSIS analysis

2.1 Modeling ideas

In order to comprehensively rank supplier enterprises and select the most important supplier groups, we have collect data via internet and will quantitatively analyze the data system of 402 enterprises in two dimensions within 240 weeks through three variables (effective residual D, effective average supply s and effective average weeks w) in two dimensions (production credit C_{ij}

and production capacity A_{ij}), So as to help production enterprises make scientific decisions. When evaluating and ranking enterprise capabilities, we introduce the supplier comprehensive ranking evaluation function (P). On this basis, we can get the comprehensive ranking expression group to quantify the data.

$$P = f(C_{ij}, A_{ij}) \tag{1}$$

$$\begin{cases} C = f(D_{x,y}) \\ A = f(S_{x,y}, W_{x,y}) \end{cases} \tag{2}$$

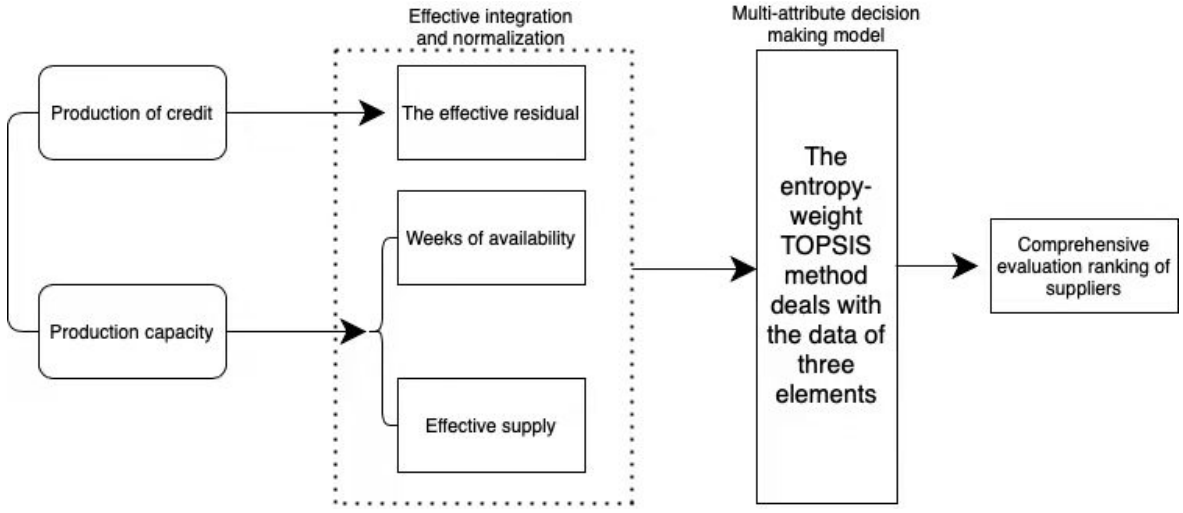

Figure 1: The idea of the model.

2.2 Modeling preparation

2.2.1 Transformation of key issues

We analyze and process the order quantity of enterprises and the supply quantity of suppliers, and select the best supplier group. At this time, we introduce the supplier comprehensive ranking evaluation system and transform it into evaluation problems.

2.2.2 Integer processing

It can be seen from Annex I given in question 1 that the supplier's supply quantity is closely related to its order quantity, while in some cases, both supply quantity and order quantity are 0. Therefore, it is found that the supply quantity is 0, which is directly caused by the order quantity is 0, and there is no correlation between the two dimensions of production reputation and production capacity. We choose to use integer 0 processing, and move back the data with 0 in both tables through MATLAB. By zeroing, we can easily get the two variable values of effective weeks and effective supply data.

2.2.3 Normalization processing

Normalizing the supply and order quantity data is of great significance for the establishment of the evaluation system. By vertically comparing the two data groups, it can be found that the distribution domain of order and supply quantity data of different manufacturers in a week is large, which is not conducive to the establishment of the evaluation system. We use the normalization method to process the data and make it distributed in the interval of 0 to 1. Because the data set of this modeling is huge and the data is very large, the calculation pressure can be greatly simplified through this method. At the same time, it is easier to establish the residual model.

The basic concept of normalizing data is to transform a dimensional expression into a dimensionless expression and become a scalar. This method will be used in a variety of calculations. In data standardization, the most typical is data normalization, that is, data unified mapping and 0-1 interval. Normalization has the meaning of identity, unity and unity. At the same time, its specific function is to summarize the statistical distribution of unified samples, improve the convergence speed of the model and improve the accuracy of the model. Normalization processing is widely used, such as the normalization of Schrodinger equation, normalization in image processing, etc. the normalization used in our data processing is similar to the latter, which uses Euclidean distance as the judgment function, and its formula is as follows:

$$D(i,j) = \sum_{m=1}^{M} \sum_{n=1}^{N} \left[S^{ij}(m,n) - T(m,n)^2 \right] \tag{3}$$

In this data processing, we adopt the min max standardized method to normalize the enterprise's order quantity and the supplier's supply quantity respectively. Firstly, we make a linear transformation on the original data to make the result fall into the [0,1] interval. The data provided are analyzed with the help of SPSS, and the value of coefficient constant K can be obtained. Its expression is:

$$K = \frac{b-a}{max - min} \tag{4}$$

Finally, the data expression can be normalized to the interval [a, b]:

$$\begin{cases} Y = a + k(x - min) \\ A = s + k(x - max) \end{cases} \tag{5}$$

Thus, all the data of enterprise order quantity and supplier supply quantity are normalized, and the data processing part is completed.

2.3 Multi attribute decision model

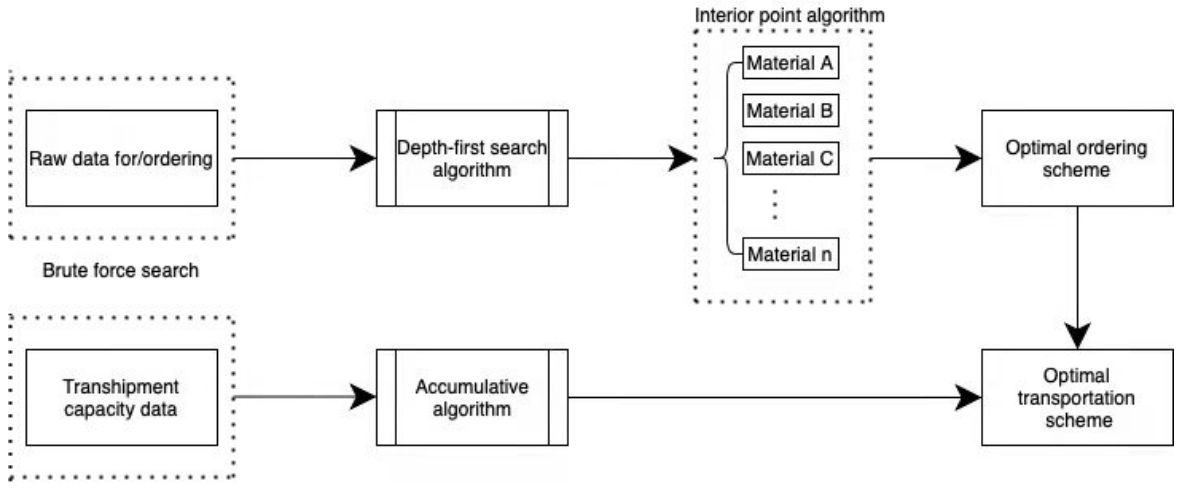

Figure 2: The idea of the multi attribute decision model.

2.3.1 Concept of multi-attribute decision making

Multi-attribute decision-making, also known as limited scheme multi-objective decision-making, refers to the decision-making problem of selecting the best alternative or ranking schemes under the

consideration of multiple attributes. It is an important part of modern decision-making science. Its theory and method are widely used in engineering, technology, economy, management, military and many other fields. The main problems of multi-attribute decision-making are evaluation and selection. In this experiment, we analyze the variable factors obtained in data processing: effective weeks, effective supply and effective residual, and bring them into TOPSIS model.

2.3.2 Improved multi-attribute decision making model based on TOPSIS method

TOPSIS is a method of ranking according to the proximity between a limited number of evaluation objects and idealized objectives. It is to evaluate the relative advantages and disadvantages of existing objects. TOPSIS method is a sort method which approximates to the ideal solution. This method only requires each utility function to be monotonically increasing (or decreasing). TOPSIS method is a commonly used and effective method in multi-objective decision analysis, also known as the good and bad solution distance method.

2.3.3 Determining the weight of factors by entropy weight method

For the multi-attribute decision-making model, the most important two points are attribute weight and attribute. We have determined three factors as the attributes of our decision-making model, so we need to weight these three factors. However, entropy weight method has natural advantages for TOPSIS model. Firstly, according to the explanation of the basic principles of information theory, information is a measure of the order degree of the system, and entropy is a measure of the disorder degree of the system. With this feature, the dispersion degree of the index and its whole can be calculated through entropy, and the weight of each index can be calculated, which provides a basis for multi index comprehensive evaluation.

We have to deal with a large amount of data, so it is particularly important to select representative data features. Through the formula calculation of entropy weight method, we can give weight to the set variables and optimize the comprehensive evaluation system. First, forward and standardize the data. The formula is as follows:

$$z_{ij} = x_{ij} \sqrt{\sum_{i=1}^{n} x_{ij}^2} \tag{6}$$

Next, we need the probability matrix P_{ij}

$$p_{ij} = \frac{\overline{z_{ij}}}{\sum_{i=1}^{n} \overline{z_{ij}}} \tag{7}$$

Finally, we can calculate the information entropy of each index:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^{n} p_{ij} \ln p_i \tag{8}$$

Through the process of entropy weight method, we can adjust the weight relationship between the three variables, which is more conducive to the fairness of the final comprehensive evaluation system.

2.3.4 TOPSIS model modified by entropy weight method

Firstly, we can build a comprehensive evaluation system decision-making problem, and select the optimal entropy weight through the weighted three variable factors (effective residual, effective weeks and effective supply), so as to build a decision matrix. At the same time, perform the same steps as TOPSIS, quantify and standardize the processing data, and calculate the weighted attribute

value.

$$r_{ij} = \frac{\alpha_{ij}}{\sqrt{\sum_{k=1}^{m} x_{ij}^2}} \tag{9}$$

$$v_{ij} = \mathrm{w_j} \times r_{Ij},\ \sum_{i=1}^{n} w_j = 1 \tag{10}$$

Determine the positive ideal solution and negative ideal solution, and consider the distance between positive and negative ideal values. From this, it can be calculated that the distance of positive ideal value PIS is:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_J^+\right)^2} \tag{11}$$

Then the distance of negative ideal PIS is:

$$d_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_J^-\right)^2} \tag{12}$$

2.4 Summary

We build a reasonable evaluation system to help enterprises make decisions. Due to the large number of data and uneven data distribution, it is impossible to directly evaluate with the original data. Therefore, we adopt two important data processing methods, namely, zeroing and data normalization, so as to obtain the normalized data of enterprise order quantity and supplier supply quantity. Since we selected three factors as our evaluation factors, we chose TOPSIS Model in the multi-attribute decision-making model. When we first processed the data, we found that the supply curve of many enterprises was not very ideal, and we introduced entropy weight method to modify TOPSIS model. Finally, we can get the most satisfactory suppliers.

3. Model Evaluation

This model has many reference and adopted algorithms, and has good robustness. This model preprocesses the data before modeling, which makes the data more real and reliable. But the amount of data is large, and it is difficult to process the data. During the simulation, it is found that the accuracy is relatively low.

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